REMARKS/ARGUMENTS

Claims 1-29 are pending. Claims 1, 2, 5, 15, 21 and 26 have been amended, and new claim 29 has been added. No new matter has been introduced by the new or amended claims.

All the pending claims of the subject application comply with all requirements of 35 U.S.C. Accordingly, Applicant requests examination and allowance of all pending claims.

Office Action Summary

Claims 1-13, 15, 18, 21, 22 and 25-28 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Chiang et al. (6,428,859) in view of Sherman (6,342,277), Chiang et al. (2002/0197402) and Machida et al. (4,732,761).

Claim 14 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Chiang et al. '859 in view of Sherman, Chiang et al. '402 and Machida et al. and further in view of Qian et al. (5,571,576).

Claims 16, 17, 19, 20, 23 and 24 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Chiang et al. '859 in view of Sherman, Chiang et al. '402 and Machida et al. and further in view of Grimbergen et al. (6,406,924)

The Rejections Under 35 U.S.C. 103(a)

All of the pending claims stand rejected under 35 U.S.C. 103(a) as being unpatentable in view of Chiang et al. '859 (the primary reference) in combination with one or more other secondary references including Sherman (6,342,277) and Machida (4,732,761). The rejections are respectfully traversed.

Claim 1 (and its dependents)

On July 27, 2006 Applicants had amended claim 1 to recite that silicon-containing reactant was converted into silicon glass "using thermal energy to drive the deposition reaction" and argued that the Chiang et al. '859 reference was thus distinguishable over claim 1 because Chiang uses kinetic energy associated with high energy ion bombardment rather than thermal energy to drive its deposition reaction. The current Office Action maintained the rejection of claim 1, however by stating that the temperature range used in Chiang et al. (e.g., 300-350

degrees C) is capable of thermally driving the reaction. See Office Action, page 10, Response to Arguments section.

Claim 1 has been further amended such that it recites, in part:

> "converting the silicon containing reactant into a silica glass insulating compound using primarily thermal energy to provide activation energy to drive the deposition reaction" (emphasis added).

While the temperature used in some embodiments of Chiang et al. '859 provides thermal energy that may help drive the reaction, it quite clear that temperature is a "secondary control variable" of the reaction (see col. 6, lines 62-67) and not the primary means of activation energy as required by amended claim 1. Instead, Chiang et al. '859 uses ion imparted kinetic energy as the primary reaction driving mechanism. Col. 6, lines 60-62; see also col. 5, lines 59-65; col. 6, lines 3-8; col. 7, lines 10-12; col. 8, lines 47-48; and col. 9, lines 50-56.

Applicants further note that a combination of the Chiang et al. and Sherman references also does not result in the invention of amended claim 1. For example, Sherman does not teach biasing the substrate to promote sputtering during the ALD process as recited in claim 1. To the extent the Examiner believes this concept is taught or suggested by Chiang et al., Applicants note that Chiang et al. biases the substrate in order to effect an ion-induced reaction mechanism at the substrate's surface which is driven by kinetic energy as opposed to thermal energy. Thus, if a skilled artisan were to look to the teaching of Chiang et al. and bias the ALD reaction taught in Sherman in the manner suggested by Chiang et al., the resulting ALD reaction would be driven by kinetic energy and not by thermal energy as recited in claim 1.

In view of this clear distinction between claim 1 and the applied references, Applicants respectfully assert that claim 1, as amended, is patentable over the combination of Chiang et al. and Sherman. Applicants also assert that claims 3-14, 16, 18, and 27, which depend from claim 1, are in condition for allowance for at least the reasons discussed in relation to claim 1, as well as for the additional elements they recite.

Claim 2 (and its dependents)

On July 27, 2006 Applicants had previously argued claim 2 was allowable over the prior art because the art did not teach "wherein the average atomic mass of all atomic constituents in the second reactant is less than or equal to an average atomic mass of oxygen."

The current Office Action rejected this argument by stating "Chiang et al. suggest the use of hydrogen for sputtering and Sherman suggest the use of oxygen." See Office Action, page 10, Response to Arguments section. The Examiner is reminded that for Section 103 rejections the Examiner is required to set forth: (i) the relevant teachings of the prior art preferably with reference to relevant column or page numbers and line numbers; (ii) the differences in the claim over the applied references; (iii) the proposed modification of the applied reference to arrive at the claimed subject matter and (iv) an explanation as to why a person of skill in the art at the time of the invention would have been motivated to make the proposed modification. MPEP §706.02(j). None of that is done in the present case. Accordingly, Applicants are unclear as to exactly how the Examiner is combining the Chiang and Sherman references in rejecting claim 2. In absence of details as to how the combination is made and the motivation for the combination, Applicants respectfully assert that a *prima facie* case of obviousness has not been established.

In order to expedite prosecution of the present invention, however, Applicants provide the following comments and amendments to claim 2, which pertains to a ALD method of depositing silica glass. Claim 2 recites that a substrate is exposed to a silicon-containing reactant that is adsorbed onto the substrate and that the silicon-containing reactant is then converted into silica glass by exposing the substrate to oxygen radicals. Claim 2 has been amended to clarify that the "average atomic mass of all atomic constituents introduced into the chamber during the converting step is less than or equal to an average atomic mass of oxygen." Applicants respectfully assert that this limitation is neither taught or suggested by the prior art alone or in combination.

Chiang et al. '859 does not teach a specific method or process to form silica glass at all. Instead, Chiang et al. broadly describes an ALD process that uses ion imparted kinetic energy to drive the deposition process. A person of skill in the art would appreciate that when the teaching of Chiang et al. is applied to deposition of a silica glass film, some sort of oxygen-containing source is required as the "second reactant" since oxygen is required to convert silicon into silicon oxide and that an appropriate feed gas is also required to drive the deposition process according to the ion imparted kinetic energy technique taught by Chiang. Chiang specifically describes several feed gases that can be used for ion generation including Ar, Kr, Ne and Xe (col. 7, lines 5-7) each of which has an atomic mass heavier than oxygen. The combination of an

oxygen source and one of the feed gases described in Chiang result in the constituents introduced into the chamber during the converting step having an average atomic mass greater than oxygen. Accordingly, it is clear that Chiang et al. neither teaches or suggests that the "average atomic mass of all atomic constituents introduced into the chamber during the converting step is less than or equal to an average atomic mass of oxygen" as required by claim 2.

To the extent that the current Office Action is arguing Chiang et al. teaches that hydrogen can be the sputtering source that imparts sufficient kinetic drive the reaction according to the Chiang's teaching of modulated ion-induced ALD (MII-ALD), Applicants strongly disagree. Applicants can find no teaching in Chiang et al. that hydrogen can be used as the ion feed gas to drive an MII-ALD reaction. The only references Applicants could find within Chiang to hydrogen concern using hydrogen as a second reactant and not an ion source for bombardment. See e.g., col. 9, lines 4-24 (discussing using H as the second reactant in the deposition of aTaN); see also col. 12, lines 16-27 (discussing that using H as the second reactant can result in a combined chemical (effect of H) and physical (effect of ion source such as Ar) reaction. If the Examiner disagrees, Applicants respectfully request that the Examiner specify the column and line numbers within the Chiang et al. reference where using hydrogen in this manner is taught or suggested.

To the extent that the Office Action is arguing Sherman teaches this aspect of claim 2 because it teaches that the oxygen can be the second reactant, Applicants note that a combination of the Chiang et al. and Sherman references also does not result in the invention of claim 2. For example, Sherman does not teach biasing the substrate to promote sputtering during the ALD process as recited in claim 2. To the extent the Examiner believes this concept is taught or suggested by Chiang et al., Applicants note that Chiang et al. biases the substrate in order to effect an ion-induced reaction mechanism at the substrate's surface by using a relatively heavy inert gas such as Ar, Kr, Ne and Xe (col. 7, lines 5-7). Thus, if a skilled artisan were to look to the teaching of Chiang et al. and bias the ALD reaction taught in Sherman in the manner suggested by Chiang et al., the converting step would use a combination of oxygen and a heavier ion source and be heavier rather than equal to or less than the average atomic mass of oxygen as recited in claim 2.

In view of the above, Applicants respectfully submit that the prior art does not teach or suggest all the elements of claim 2 in the manner claimed. For at least these reasons, claim 2 is patentable over Chiang et al. '859 and Sherman. In addition, claims 19-22 and 28, which depend from claim 2, are patentable for at least the reasons discussed in relation to claim 2, as well as for the elements they recite. If the Examiner disagrees and maintains the Section 103 rejection of claim 2, Applicants respectfully request that the next Office Action comply with the requirements of Section 706.02(j) of the MPEP and specifically set forth the detailed information required by the MPEP when making a Section 103 rejection.

Claim 15 (and its dependents)

Claim 15 recites, in part, that "the silica glass film grows up from the bottom surface of the gap at a rate greater than it grows inward on the sidewall surface of the gap." As a result of the difference in growth rates between the bottom and sidewall surfaces, the film deposited by the invention of claim 15 is nonconformal. Applicants respectfully assert that neither Chiang et al. '859 nor Sherman teach or suggest this aspect of the invention of claim 15.

Chiang et al. '859 describes the challenges associated with depositing a conformal thin film. See col. 1, lines 27-35 and the "Brief Description of the Prior Art" generally. Chiang et al. '859 then states that "[t]he present invention relates to methods and apparatuses useable for the deposition of conformal solid thin films." Col. 5, lines 34-36. Likewise, Sherman also describes the challenges associated with depositing a conformal film over large area wafers. Col. 3, lines 1-7. Sherman then claims, in the "Summary of the Invention," the ability to deposit a film one monolayer at a time that "tends to be conformal and have uniform thickness." Col. 5, lines 21-23; see also col. 12, lines 43-45. Thus, neither Chiang et al. '859 nor Sherman teach or suggest a process where the film "grows up from the bottom surface of the gap at a rate greater than it grows inward on the sidewall surface of the gap" as recited in claim 15.

Applicants further note that one of ordinary skill in the art would not have been motivated to combine Chiang et al. '859 and Sherman with Machida to obtain the invention of Claim 15. Machida discusses simultaneous deposition and etching to planarize a film; however, this aspect of Machida, which results in the deposition of a nonconformal film, would render both Chiang et al. '859 and Sherman unsatisfactory for their intended purpose of depositing

conformal films. Since the modification would render the prior art unsatisfactory for its intended purpose, there is no suggestion or motivation to make the modification. See MPEP 2143.01.

Accordingly, Applicants respectfully submit that Claim 15 is patentable over the combination of Chiang et al. '859, Sherman, and Machida. Further, Claims 23-26, which depend from Claim 15, are patentable over Chiang et al. '859, Sherman, and Machida for at least the reasons discussed in relation to Claim 15, as well as for the additional elements they recite.

New Claim 29

New claim 29 has been added to secure an appropriate scope of protection for the present invention. Support for the claim exists in the specification, drawings, and claims as originally filed. For example, support for the growth rate of the silica glass film on bottom and sidewall surfaces of the gap exists at least at page 7, paragraph [0025].

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance and an action to that end is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 650-326-2400.

Respectfully submitted,

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